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PAPER NO. 1

OUR WATER SUPPLY

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A PRACTICAL PAPER BY DR. AGNEW ON THE SUBJECT.

Suggestions as to the Water we Drink, and Where to Get it from.

A meeting of the Historical Society was held Thursday evening, Mr. A H. Whitcher, Vice-President, in the chair.

The following paper was read by Dr. Agnew on the subject of

WATER.

If a chemist were asked the question, What is water? he would answer: Water is an oxide of hydrogen. These tasteless, odorless and colorless gases unite in the proportion of two volumes of hydrogen and one of oxygen; or, by weight, one part of hydrogen and eight parts of oxygen to form water.

Water is a fluid, and has the following physical properties when pure:—It is tasteless, odorless, colorless and transparent; a powerful refractor of light, a bad conductor of light and electricity, and very slightly compressible. It is at its greatest density at 40° Fahr., it becomes solid at 32°, and is vaporized at 212° Fahr., and is in the liquid form only at temperatures lying between these two extremes. Its specific gravity is 1, which is the unit to which all specific gravities are referred.

Water exists in great abundance on the earth, about three-fifths of its surface being covered with water. This grand reservoir is the source whence all the supplies for the operations of nature and the wants of man are derived. Without the oceans this fair world would be a barren waste. No cloud would intercept the sun's fierce rays; no bubbling spring would cheer the thirsty wayfarer; no purling stream would gladden with its soft music; no umbrageous tree would lure with its cool shade; no "wee crimson tippit flower would soothe the eye.

Water is an almost universal solvent; hence it is never found pure in nature. Rain water, which is considered the purest, contains carbonic, nitrous, nitric, sulphurous and sulphuric acids, and various ammoniacal and calcium salts, as also nitrogenous organic matter; and occasionally microscopic plants such as the Protococcus pluvialis, and others of a low order. Where rain water has percolated through the earth, and reappears in springs, and brooks, and rivers, and lakes, it is always charged, to a greater or lesser extent, with salts derived from the strata through which it has percolated. When the proportion of these inorganic impurities is small, the water is said to be soft, and when larger it is called hard. Hard water is the pleasantest for drinking. Absolutely pure water can only be obtained by distillation, and, consequently, distilled water is best adapted to chemical purposes.

Water for domestic purposes, and for the supply of towns and cities, is derived from direct rainfall, springs, wells, rivers or lakes.

Rain water is usually collected from the roofs of houses, and, consequently, is never obtained in perfect purity, but, inasmuch as the supply from this source would be quite inadequate to the wants of a city for domestic purposes, it is unnecessary to consider it further than to remark that in badly watered districts, where the rainfall at certain seasons is considerable, the water from hill-sides might be collected and stored in artificial reservoirs.

There is no important difference between the water of springs and wells; both are impregnated with soluble salts from the strata in which they are situated. The quality of water from these sources, depends upon so many circumstances that little can be said, except in a general way:—The mere fact of water being from a spring or well is no guarantee of goodness, as is sometimes imagined. If the total solids, consisting of sodium and calcium carbonates, sodium sulphate and chloride, or magnesium sulphate does not exceed 30 grains per gallon, and there is only a trace of ammoniacal salts, the water may be usable. If at any time such water

should become turbid, or should acquire a taste or smell, it should be looked upon as suspicious. Other things being equal, water from deep wells is the best. Water from this source has been obtained from the earliest times. Jacob "digged a well," from which many hundred years afterwards water was obtained to quench the thirst of Jacob's Lord, and which has yielded water, pure and wholesome, down to recent times. And who amongst us is not familiar with the old well sweep, and the moss-covered bucket dangling from it: and who among us has not sent it to the dark depths of the old well, and rejoiced at its return; with its cool, sparkling, limpid freight, and gleefully sung with the poet:

"How sweet from the green mossy brim to receive it,
"As poised on the curb it inclined to my lips,
"Not a full blushing goblet could tempt me to leave it.
Though filled with the nectar that Jupiter sips.

Artesian wells are of comparatively recent date, and may be said to be a "new thing under the sun." The first we have an account of was bored in the district of Artois, in France, hence the name. Artesian wells are now common in France, England and America. Water from this source is often abundant; and if free from inorganic salts is wholesome, as there is no risk of organic impurity.

Rivers yield an inexhaustible supply, but the water is of very variable degrees of purity, both organic and inorganic. During the annual freshets especially, but also on the occasion of a heavy rainfall, the amount of organic and inorganic impurity is greatly increased, so much so that when a supply is drawn from that source, extensive settling basins are required. Generally, however, river water is softer than water obtained from springs or wells.

Great lakes are the best of all sources of water supply. They are settling basins of immense magnitude; hence the water of great lakes is purer than the water of the rivers that flow into them. Suspended inorganic matter falls to the bottom; inorganic matter in solution does not increase, for the out-flow is equal to the in-flow; and organic matter is quickly oxidized, and rendered innocuous.

As the water-supply of Winnipeg is attracting a great deal of attention at present, and as it must become a question of the greatest importance in the near future, allow me briefly to examine each of those sources from which supply might be obtained. I may pass without remark rainwater and springs, water from dug or surface wells need only be mentioned to be condemned, for water from such a source is only filtered sewage; and although it may be apparently pure and sparkling, and unobjectional to the taste, it may contain the germs of typhoid and other deadly diseases. (During my residence in Toronto I traced many cases of typhoid fever to the wells.) There remains, then, only three sources to be examined, viz.: Artesian wells, rivers and lakes.

Water from properly tubed artesian wells is free from any suspicion of surface impurity, but the geological formation of the district necessarily influences the composition of the water percolating through it. Water from the granite formation is the best, although the chalk water is the pleasantest for drinking, on account of the considerable amount of carbonic acid with which it is charged. Limestone waters are of agreeable taste, but they generally contain a good deal of calcium sulphate, and, if there is any dolomite in the formation, there may be more magnesium sulphate than most persons would desire, whilst a considerable amount of selenite would render the water unwholesome, owing to the amount of calcium sulphate with which it would be charged.

From a geological point of view, Manitoba occupies a favorable position for obtaining a good water supply from artesian borings. What now appears level prairie was once a deep Azoic ocean, bounded on the east and west, and probably on the south, by walls of primitive rock. By and bye, in the Eons of the Past, this depression was gradually filled up by sedimentary rocks of the Silurian and Cretaceous systems and referable to the Palæozoic and Mesozoic periods. Winnipeg, therefore, is underlaid, it may be at no great depth, with limestone of these formations, the water from either of which we have seen to be good, and it is more than probable that a boring of from one to two thousand feet in depth would tap an inexhaustible supply.

Artesian wells have stood the test of more than one hundred years. At Grenelle, near Paris, there is a well 1,798 feet deep, which yields 864,000 gallons per diem. Another at Passy, 1,923 feet deep, with a diameter, at the bottom, of 28 inches, which discharges 5,582,000 gallons per day, to a height of 54 feet above the surface. And at Chicago there are two wells, one 700 and the other 1,000 feet deep and five inches diameter, which

yield 800,000 gallons daily. Computing the population of Winnipeg at 30,000, 450,000 gallons per diem would be required for domestic purposes, at the minimum allowance of fifteen gallons per capita, per diem, and if all household and manufacturing purposes are included, then 35 gallons for each person, or a total of 1,050,000 gallons would be required. It may reasonably be expected, therefore, that one or two such wells of six or seven inches diameter would be amply sufficient to supply the wants of this city for a good many years.

Rivers:—Either the Red River or the Assiniboine might be depended upon to yield an inexhaustible supply for all time to come, but the quality is none of the best, and as towns and cities are built along the course of these streams, and the general drainage of the country as well as the sewage of cities is discharged into them, it cannot be expected to improve. For an analysis of the water of these rivers I beg to refer you to Dr. Bell's report of the Dominion Geological Survey, copied into the "Report of the Department of Agriculture and statistics of the Province of Manitoba for 1882."

The water of the Assiniboine is particularly objectionable on account of the quantity, nearly eight grains to the gallon, of sulphate of magnesia, or Epsom salts, which it contains. Of course that might be got rid of by chemical means, but the process is both costly and troublesome. The suspended matter could only be removed by filtration; a process altogether too costly to be applied so extensively. And when it is considered that the most careful filtration cannot be depended upon to remove the germs of typhoid fever, dysentery, cholera, and other zymotic diseases, these rivers have but to be named to be rejected as a permanent source of supply for this city.

Lakes:—Unfortunately Winnipeg is not situated near any great lake, but this circumstance is more than compensated for by the elevation of the great lake to which we must ultimately look for a supply of water should Winnipeg, as is expected, become the commercial metropolis of the Northwest. In March, 1883, in a letter to the Free Press, I directed attention to the Lake of the Woods as the grandest reservoir to which we must ultimately look. This beautiful lake, embosomed in laurentian rocks, is about 300 feet higher than Winnipeg, at a distance of about 60 miles, and as there is no intervening height of land, the water might be brought by a system of canaling and pipes to the top of Bird's Hill, and from that elevation distributed to the city by the ordinary system of distribution pipes. Should this plan be found feasible in practice, the first cost would be the only cost.

I regret that I have not an analysis of the water from the Lake of the Woods, to which I can refer you, and I also regret that I have not had an opportunity of examining the water physically, but there can be no doubt that, from the geologic situation of the lake and its catchbasin, the water is not surpassed for purity on this continent.

At the conclusion of the reading of the paper, Rev. Prof. Hart moved a vote of thanks to the lecturer, the motion being seconded by Dr. Rolston and Dr. Blanchard, and unanimously carried.

Prof. Hart suggested a question as to the practicability of obtaining a supply of water for the city from Lake Manitoba. Dr. Agnew thought the height of that lake insufficient for the purpose. The Chairman believed, from information which he had obtained, that the lake was eighty feet higher than Winnipeg.

Dr. Blanchard thought the deposits of green vegetable matter in summer, especially about the bays, were an objection to the use of the water of the Lake of the Woods. He suggested Whitemouth, on the Winnipeg River, as a preferable starting point, being fifty miles distant from this city, while the swift current and the falls purified the water. Judging from the success of artesian wells in other cities, notably Brooklyn, he thought that this system could be very successfully worked here.

Mr. R. E. W. Goodridge considered that the artesian wells seemed to promise the most direct means and to present fewer difficulties.

Dr. Agnew, in answer to Prof. Hart, said that the city wells, though called artesian, were not properly such. As to their freedom from surface water, that depended upon the tubing. An artesian well 1,000 to 1,500 feet deep might be bored in about three months, and at a cost of probably $3,000 to $5,000. There would be very little risk of not striking water-bearing strata, and it was surely worth while that Winnipeg should spend that amount upon such an experiment.

Mr. Hughan spoke of the difficulties caused in England by water pipes freezing. He did not see how in this severe

climate water could be successfully distributed in pipes.

The meeting then adjourned.

A meeting of the executive council of the society was to have preceded the general meeting, but, owing to there being no quorum present it did not take place. A number of propositions for members had consequently to be postponed.